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THE DISTRIBUTION OF AND CORRELATION BETWEEN EYE, HAIR AND SKIN COLOUR
in Male Students at the University of Stellenbosch

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With IX Tables

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ABSTRACT

This paper is a contribution to the Physical Anthropology (Somatoscopy) of the European male population of the Union of South Africa. The eye, hair and skin colour of 133 male students of the University of Stellenbosch were determined with the standardised colour tablets generally used, viz. Rudolf Martin's Eye Colour Tablet; E. Fischer's Hair Colour Tablet; and von Luschan's Skin Colour Tablet. Hair colour here includes colour of beard, hair on scalp, on body, and around genitalia; skin colour, colour of skin (untanned), and colour of the highly pigmented areas such as nipples and the genitalia. The percentage distribution of the various colours are recorded in tabular form, and in the case of hair colour compared with that obtained by Schlaginhaufen for Swiss recruits. For eye colour the distribution was:

Brown 30·1%, Intermediate (grey, greenish to very light grey) 43·6%, Light (blue to very light blue) 26·4%.

For hair colour:

Black 2·1%, Brown 82·3%, Blond 13·3%, Red 2·1%. That the percentage for red was as high as 2·1% is accounted for by the fact that the students were mostly of Dutch descent, and that in other cases one or both of the parents were of English, Scotch, Irish, or German descent.

The correlation between eye colour and hair colour, and that between eye colour and skin colour (untanned) are recorded in correlation tables, and the correlation coefficients (r) were calculated. For eye and hair $r = 0{\cdot}3996$ (highly significant) for eye and skin (untanned) $r = 0{\cdot}1215$ (not significant).

The intensity of the skin pigment on the areas mentioned above is recorded in tabular form. Brief mention is made of the correlation between hair colour, and beard colour, and colour of hair around genitalia.

CONTENTS

INTRODUCTION; SOURCE OF MATERIAL; APPARATUS USED

This paper is an account and analysis of somatoscopic observations carried out on male students at the University of Stellenbosch. The author has confined himself to eye, hair and skin colour only. The only investigation of a similar nature on the European population of South Africa is a work by Van der Westhuyzen (1929). For the determination of the iris colour, the eye colour tablet by Martin was used; of the hair colour, the hair colour tablet by E. Fischer; and of the skin colour, von Luschan's skin colour tablet as described by Rudolf Martin (1928).

Pigmentation has acquired considerable importance in anthropology for the reason that, although its distribution can be very different in the different coloured races, their vitality is not affected thereby in any definite way. As a racial characteristic its inheritance is regular. Its development in the individual is gradual so that it may be modified through external influences — in negro children, the pigment is formed only within the first few months after birth (Fritsch 1912). It is, however, only the inherent capacity for pigment formation that is inherited. The intensity of pigmentation in the adult may vary considerably according to the influence of external conditions on its production. It is for this reason that those races who can readily react with their quantum of pigment to a changing environment have a better prospect of establishing themselves than those who lack this capacity.

With regard to the inheritance of eye, hair and skin colour, it is now generally accepted that this is governed by the simultaneous action of many genes: the loss of one or more of such genes in crossings is responsible for resultant colour differences in the offspring. The frequent occurrence of red hair among Scotchmen, Irishmen and oriental Jews, says Hauschild (1926), can be ascribed to the loss of a colour factor.

The colour of the skin and its appendages is due to the amount of pigment it contains and the distribution thereof. The number of pigment granules in cells is very variable. Differences in skin colour also depend upon the position of the pigment-containing cells. According to the colour of the pigment itself, the iris, hair or skin appears yellowish or dark brown. The black retina pigment covering the inner surface of the iris appears blue when seen through the dull superficial layer.

Pigmented, stellate, connective tissue cells are formed in the sclerotica, the dermis and the iris; pigmented epithelial cells in the epidermis and conjunctiva. Hair pigment is located chiefly in the hair cortex in heavily pigmented hair, also in the medulla (Frederic 1907). The distribution of pigment in the body is laid down during development. Weidenreich (1912) distinguishes between skin pigment which may be epidermal or dermal, a perineural (pigment of the nervous system), a peri-coelomatous (pigment surrounding the body cavity), and a perivascular (pigment surrounding the blood vessels). It is of course the skin pigment that is of primary importance in the study of races. In man it is more developed than in any other primate. Its ontogeny seems to indicate that it is of fairly recent origin in the phylogeny of the Primates (Weidenreich 1912), thence its remarkable variability in races and individuals.

Besides the direct influence of the rays of the sun on the colour of the skin, producing the suntanned skin colour, the production of pigment is inhibited or accelerated by internal secretions, and hormones produced in the genital organs are responsible for the heavier pigmentation of the genitalia.

Davenport (1910) was the first to observe that in crossings between individuals with different skin colour, the F_2-generation gives rise to numerous colour types,

thereby proving that numerous genes contribute to the production of the skin colour of the offspring. Skin and iris colour arise in the same way during development. The epidermis pigment corresponds to the pigment of the conjunctiva (absent in Europeans generally, but yellowish in the coloured races), the dermal, to the pigment of the cornea and iris. Eye pigment, however, includes the perineural or retinal pigment covering the inner surface of the iris. When this pigment alone is present in the iris, the eyes are blue, and, when also the retinal pigment component is absent, we have the so-called red eyes. Cases, however, are on record (Hauschild 1909) where the iris pigment is absent, but the retinal pigment has migrated forward to lie within the iris, giving the eyes a brown instead of a blue colour.

What has been noted in connection with the inheritance of skin colour in general also applies to the inheritance of eye colour. It is for this reason that in races there is a definite correlation between eye and skin colour. In crossings between races this correlation is often interrupted, so that blue eyes are found with a dark, brown eyes with a light coloured skin. Since hair is a derivative of the skin layer, there is also a correlation between hair and eye colour, and, as in the case of eye colour and skin colour, the correlation is sometimes interrupted. In the material that came under his observation, the author found a few very uncommon combinations, e.g. very dark brown to slaty coloured hair (Fischer's hair colour tablet nos. 30, 4) combined with greenish eyes (Martin's eye colour tablet no. 8). Another interesting combination was very dark brown hair (no. 4) with blue eyes (no. 13).

The very large variety of eye colour among Europeans is partly due to the co-operation of the iris pigment with the retina pigment on the inner surface of the iris (speckled eyes, green eyes), and partly to the number of unpigmented connective tissue cells in the iris itself.

OWN INVESTIGATIONS

1. Eye Colour

TABLE I

Very dark brown ...	Nos. 2, 3	4 Ind.	3·0%	Brown 30·1%
Dark brown	No. 4	14 „	10·5%	
Light brown	Nos. 5, 6	22 „	16·5%	
Greenish	Nos. 7, 8	24 „	18·0%	Intermediate 43·6%
Dark gray	Nos. 9, 10	17 „	12·8%	
Light gray	Nos. 11, 12	17 „	12·8%	
Dark blue	Nos. 13, 14, 15	26 „	19·5%	Light (blue) 26·4%
Light blue	No. 16	9 „	6·7%	

Ind. = Individuals. The numbers opposite the different colours stand for the numbers on the eye colour tablet by Martin. No. of Individuals 133 = 100%.

In Table I the different eye colours and their percentage distribution are recorded. The darkest colour (no. 2/3) was found in 3% of the total number of individuals examined. The highest colour (no. 16) was observed in 9 individuals

(6·7%). It is customary (Schlaginhaufen 1927) to group the numbers together to form three categories: nos. 1-6, stand for blue, nos. 6/7 to 12 for intermediate, and nos. 12/13 to 16 for light (blue). In the 133 individuals examined 30·1% were brown-eyed; in 43·6% the eye colour was intermediate; and 26·4% were blue-eyed.

In Table II these results are compared with those obtained by Van der Westhuyzen, and the eye colour distribution in 250 Swiss recruits (Schlaginhaufen loc. cit.).

TABLE II

	V.d. Westhuyzen Univ. students	Grobbelaar Univ. students	Schlaginhaufen (Swiss recruits)
Brown ...	19·4%	30·1%	33·2%
Intermediate ...	37·7%	43·6%	38·4%
Light ...	42·6%	26·4%	28·4%

The percentage obtained by Van der Westhuyzen for the light group is evidently too high. The number of individuals (117) he examined was too low. It is probable that many individuals whose eye colour he grouped under no. 14 had an eye colour no. 13. It is often difficult to discriminate between Nos. 13 and 14. Niggli-Hürlimann (1930) experienced the same difficulty and preferred to include no. 13 under the intermediate category rather than to regard it as a grade of blue.

2. Colour of hair

TABLE III

Black:	No. 27	3 Ind.	2·1%	Red:	Nos. 1-3	3 Ind.	2·1%
Brown:	„ 4	46 „	33·1%	Blond:	„ 8-9	1 „	0·7%
	„ 4-5	4 „	2·8%		„ 9-10	0 „	
	„ 5	30 „	21·5%		„ 10	6 „	4·2%
	„ 5-6	2 „	1·4%		„ 11-12	0 „	
	„ 6	4 „	2·8%		„ 12	3 „	2·1%
	„ 6-7	2 „	1·4%		„ 13-25	0 „	
	„ 7	14 „	10·1%		„ 26	8 „	5·8%
	„ 7-8	6 „	4·3%				
	„ 8	7 „	5·0%				

Ind. = Individuals. The numbers opposite the colour given stand for the numbers on the hair colour tablet by E. Fischer. No. of Individuals 129 = 100%.

In Table III the hair colour and the percentage distribution of the colours observed were recorded. It is customary to group all the grades of brown (nos. 4-8, and the slaty dark brown, nos. 28, 29 and 30 of the colour tablet) together as brown; nos. 8-22 and 23-26 as blond. The groups thus formed and their percentage distribution is recorded in Table IV.

TABLE IV

	South African Students	Swiss recruits (Schlaginhaufen)
Black	2·1%	2·4%
Brown...	82·3%	81·2%
Red	2·1%	0·8%
Blond	13·3%	15·6%

The absence of light blonds (nos. 13-22) is conspicuous. On the other hand there were eight individuals (5·8 %) with light, ashy gray hair. A 2·1 % of red-haired individuals is noteworthy. In the 128 students examined by Van der Westhuyzen there were none with red hair. According to Bolk (1907), red hair is distributed equally between blonds and brunettes: the percentage given for the Netherlands is 2·5. The 2·1% obtained in my own investigation is, however, not surprising if one bears in mind the fact that the students examined were mostly of Dutch descent, or either one or both of the parents were English, Irish, Scotch or German.

The correlation between eye and hair colour is recorded in Table V.

When hair and eye colours are grouped into 6 and 9 classes respectively, and mid-class values are assigned to each class as shown in Table V, it is possible to obtain a numerical evaluation of the relationship between hair and eye colours by means of a calculated correlation coefficient. The mid-class values, somewhat arbitrary, correspond fairly well with the scales normally employed (the eye colour tablet by R. Martin and hair colour tablet by E. Fischer).

The correlation coefficient (r), which is equal to the covariance of the two variates divided by the geometric mean of the sums of squared deviations, is, in this case:

$$r = \frac{826 \cdot 0}{\sqrt{2188 \cdot 26 \times 1952 \cdot 47}}$$

$$= \frac{826 \cdot 0}{2067 \cdot 0} = 0 \cdot 3996$$

The signicance of this figure can be determined by way of the t-test :

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = 4 \cdot 99$$

According to the table of distribution of t, the probability of obtaining such a value by random sampling of an uncorrelated population is less than 1 in a thousand, and the correlation coefficient can thus be considered as highly significant.

TABLE V

On scalp / Iris	Light blond to ashy blond (16-26) 21	Dark Blond (9-15) 12	Slaty brown to light brown (6, 7, 8, 30) 7	Very dark to dark brown (4, 4-5, 5, 28, 29) 5	Black (27) 2	Reddish (1-3) 1
Very dark 1 (1)						
Dark brown 2·5 (2, 3)			0·75% (1)	1·5% (2)	0·75% (1)	
Brown 4 (4)			5·25% (7)	6·75% (9)		
Light brown 5·5 (5, 6)			5·25% (7)	10·50% (14)		
Greenish 7·5 (7, 8)		0·75% (1)	9·00% (12)	9·75% (13)		
Dark grey 9·5 (9, 10)	1·50% (2)	1·50% (2)	6·75% (9)	5·25% (7)	0·75% (1)	
Light grey 12 (11, 12, 13)	0·75% (1)	2·25% (3)	9·00% (12)	4·50% (6)		
Blue 14·5 (14,15)	1·50% (2)	2·25% (3)	4·50% (6)	0·75% (1)	0·75% (1)	0·75% (1)
Light blue 16 (16)	2·25% (3)	1·50% (2)	2·25% (3)			0·75% (1)

The numbers in brackets under eye and hair colours correspond to those on the eye and hair colour tablets. The series 1, 2, 5, 7-21 and 1, 2·5, 4·5-16 refer to the mid-class values mentioned in text.

In Table VI the colour of the beard, hair in arm pits, hair on body, if any, and hair surrounding the genitalia are recorded. Very dark, brown, reddish and blond have the same meaning here as that for hair on scalp. The large number of students who grew beards at the time (Dec. 1948) of the inauguration of the Voortrekker Monument afforded a golden opportunity for determining the colour of the beards of students who are clean shaven as a rule. From the table we note that in only 0·7%

of the individuals examined was the colour of the hair round the genitalia very dark to black (no. 27) against 3·1% with beard of the same colour. In general the hair surrounding the genitalia is a shade lighter than the hair on scalp; if the hair colour on scalp corresponds to nos. 4, 5, that of the genitalia very often corresponds to no. 6 (brown with a reddish tint). This agrees with the correlation between the two colours as reported by Martin (l.c. p. 484).

TABLE VI

Colour	Beard n = 63	Arm Pits n = 56	Body n = 48	Genitalia n = 127
Very dark ...	3·1%	0%	2·8%	0·7%
Brown	85·7%	65·1%	91·7%	85·0%
Reddish	6·2%	33·9%	0·0%	4·7%
Blond	4·8%	1·8%	6·2%	9·4%

From the Table we also note the close correspondence between the colour of the beard and the hair round the genitalia. This correspondence, however, is not maintained in the case of the reddish and light colours. The hair round the genitalia in more than one individual presented two colourations: that above the root of the penis and lower part of the abdomen being often darker in colour than that on its lateral and lower aspects and on the scrotum. This difference in colouration was found to occur more often in light haired than in dark haired individuals. Van der Westhuyzen (l.c. p. 53) found a similar state of matters in the students examined by him.

3. Colour of skin

In Table VII the percentage distribution of the untanned skin colour is recorded. It is interesting to note that " off white " (nos. 7, 8) is more often met with on the medial aspect of the upper arm than on the navel and inguinal region of the abdomen. In the latter region carmine white (nos. 9-13) and dark carmine white (beige) predominate.

TABLE VII

Colour	Abdomen (Navel and inguinal region)	Upper arm (medial aspect)
Off white (7, 8) ...	14·2%	25·9%
Carmine white (9-13) ...	64·8%	59·7%
Dark carmine white (beige) (14-18)	29·0%	14·5%

Number of Individuals 129 = 100%. As in Tables VIII and IX the numbers opposite or under the colours given stand for the number on the skin colour tablet by Von Luschan.

The heavier pigmentation of the nipples, penis, scrotum, and the ventro-median raphe of penis, is clearly demonstrated in Table VIII.

TABLE VIII

Colour	Nipples			Penis			Scrotum			Ventro median penis raphe		
	Ind.	%		Ind.	%		Ind.	%		Ind.	%	
Off white												
No. 7 ...												
„ 8 ...												
Carmine white												
No. 9 ...												
„ 10 ...												
„ 11 ...	2	1·5	1·5	9	6·9	6·9	4	3·2	3·2			
„ 12 ...												
„ 13 ...												
Dark carmine white (beige)												
No. 14 ...												
„ 15 ...	11	8·4		26	20·1		15	11·6				
„ 16 ...												4·3
„ 17 ...	5	3·8	14·5	21	16·3	44·1	5	3·8	17·0	2	4·3	
„ 18 ...	3	2·3		10	7·7		2	1·6				
Bright brown												
No. 22 ...	20	15·3					6	4·8				
„ 23 ...	55	42·1	73·5	47	36·4	38·0	44	34·1	42·7	2	4·3	4·3
„ 24 ...	21	16·1					5	3·8				
„ 25 ...				2	1·6							
Dark to purplish brown												
No. 26 ...										38	82·5	
to ...	14	10·7	10·7	14	10·9	10·9	48	37·2	37·2			91·4
„ 29 ...										4	8·9	
	129	100·2		129	99·9		129	100·1		46	100·0	

TABLE IX

Colour skin ... ... Iris	Off white Nos. 7, 8	Carmine white Nos. 9-13	Dark carmine white (beige) Nos. 14-18	Brown Nos. 22-25	n =133
Dark brown 2, 3		0·75% (1)			1
Brown 4	0·75% (1)	3·1% (4)	6·2% (8)		13
Light brown 5, 6	3·1% (4)	5·25% (7)	8·3% (11)		22
Greenish 7, 8	3·8% (5)	7·6% (10)	6·75% (9)		24
Dark gray 9, 10	2·25% (3)	12·8% (17)	3·8% (5)		25
Light gray 11, 12, 13	3·1% (4)	12·4% (16)	3·1% (4)		24
Blue 14, 15	2·25% (3)	6·75% (9)	2·25% (3)		15
Light blue 16	2·25% (3)	3·8% (5)	0·75% (1)		9

Table showing correlation between eye colour and skin colour (untanned).

For eye and skin colour (untanned) the correlation coefficient (r) = 0·1215, and t = 1·4009. This means that the chances are between 10-20 in a 100 that such a value can be obtained by random sampling. The correlation coefficient is therefore not significant.

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